

The Impact of Telemedicine on the Carbon Footprint of Patient Visits: A Case Study Using System Simulation

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Abstract

Healthcare services are one of the factors that contribute to global carbon emissions. The global healthcare system accounts for approximately 4–5% of the world's total carbon emissions. Telemedicine is a method to reduce the need for physical access to healthcare. It not only improves the accessibility and efficiency of healthcare services but is also recognized as an effective way to reduce carbon emissions from patient commuting. Previous studies have focused on patient transportation patterns. This study utilized a system simulation technique to evaluate the impact of telemedicine on the carbon footprint of patient visits. Firstly, outpatient data of the hospital were collected and organized, covering specific data such as the registration process, daily number of patients, number of emergencies, number of surgeries, etc. in each department, and carbon footprint statistics and calculations were performed on these data. The study designed two scenarios for simulation and analysis. The results of a simulation of telemedicine in a hospital in Taichung City showed a reduction in carbon emissions from patients' physical visits to the medical institution, which in turn reduced the hospital's energy consumption and resource requirements. The results show that the total carbon footprint of hospital patients is 1,512.6 tCO₂e per year and 1,225.7 tCO₂e under the current telemedicine adoption rate of 20%. As the proportion of telemedicine increases in the future, its impact on carbon emissions will increase.

Keywords

Telemedicine, Carbon Footprint, System Simulation.

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Biographies

Kun-Yeh Hsieh is a graduate student in the Department of Industrial Engineering and Enterprise Information at Tunghai University. His research interests include simulation, ESG, and healthcare improvement.

Shao-Jen Weng is a Professor in the Department of Industrial Engineering and Enterprise Information at Tunghai University. He serves as the Dean of the College of Interdisciplinary Innovation at Tunghai University. has accumulated extensive experience in academia and research since joining Tunghai University in 2009, where he

initially served as an Assistant Professor before advancing to Associate and then full Professor in 2020. He is also the Director of the Optimal Decision Systems Research Team and has been actively involved with the Healthcare Systems Consortium since 2017. Throughout his career, Dr. Weng has received numerous awards and honors that reflect his contributions to research and education. Notable recognitions include the Gold and Silver Awards from the Taiwan Institute for Sustainable Energy for his impactful work in sustainability, as well as the Outstanding Young Scholar Award from the National Science Council. He has been acknowledged for his excellence in industry cooperation and has received several teaching innovation awards. His commitment to advancing knowledge in healthcare systems has earned him the title of “Pioneer of Healthcare System Integration,” underscoring his influence in the field and dedication to improving healthcare delivery.

Yao-Te Tsai is an associate professor in the Department of Information Management at the National Kaohsiung University of Science and Technology. He has also served as the Chief Operating Officer of the Healthcare Systems Consortium and the executive secretary of the Ergonomics Society of Taiwan. Dr. Tsai received his Ph.D in the Department of Industrial and Systems Engineering at Auburn University in 2015. Dr. Tsai started his academic career as a research fellow at the Logistics Institute-Asia Pacific, National Singapore University, in 2016. In the institute, he collaborated with several FMCG companies and aimed to optimize their supply chain networks. From 2017 to 2023, he served in the Department of International Business of Feng Chia University and mainly taught/researched in the area of logistics and supply chain. In addition, Dr. Tsai started to establish partnerships with healthcare organizations and initiated more than 30 projects. The objective of these projects was all about how to improve operational efficiency in healthcare. His current research interests include supply chain management, operations management, healthcare system improvement, and ESG-related topics. Dr. Tsai’s research works can be found in the Journal of Retailing and Consumer Services, Transportation Research: Part F, Journal of Industrial Information Integration, International Journal of Engineering Business Management, etc.